ABSTRACTS OF PAPERS PRESENTED AT THE TWELFTH ANNUAL MEETING

GEOMETRICAL PROPERTIES OF MINERAL INTERGROWTHS IN ROCKS AND ORES

G. C. AMSTUTZ AND H. GIGER
Mineralog-Petrographischen Institutes der Universität Heidelberg, Germany

The intergrowth between the different minerals of a rock is a function of the genesis of the aggregate.

Previously, intergrowth relationships were considered only from a qualitative point of view (Rosenbusch's School). The present paper defines some basic metrical and topological properties. The possible correlation of these numbers to qualitative statements is discussed in application to some rocks and ores, following up some preliminary observations by Amstutz. The basic stereological formulae of Delesse, Tomkeieff and Henning, and de Hoff are valid for a class of very general structures in three-dimensional space. It is shown how one can determine the different functionals (densities) by counting and measuring in sections only. These basic formulae are:

$$\begin{aligned} V_V &= \quad a_a = l_l = c_p \\ S_V &= (4/\P)b_a = 4c_l \\ M_V &= 2\P c_a \\ C_V & \end{aligned}$$

V_V, S_V, M_V, C_V are the densities of volume, surface, integral of mean curvature, and Eulerian characteristic respectively of the structure; a_a, b_a, c_a are the densities of area, length of the boundaries, and Eulerian characteristic respectively of the structure in a section plane; l_l, c_l are the densities of the length of the segments and the Eulerian characteristic respectively of the structure in a straight line of a section; c_p can be interpreted as the probability that a random point lies within the structure.

A new method to determine c_a will be discussed. The possibility to determine C_V will be indicated. In a rock (mineral aggregate), with discrete grains, C_V corresponds to the number of grains per unit volume.

The metrical matrices V_V, S_V, M_V, C_V of the different phases can be supplemented by the following matrix of coordination, describing the mean distribution of the different phases in a mineral aggregate with discrete grains (analogous to some extent to the method proposed by Gucer):

$$K(i, k) = N(i, k) \cdot N / N(i) \cdot N(k) \cdot$$

$N(i, k)$ equals the number of particles of the ith phase intergrown with the particles of the kth phase; $N(i)$, $N(k)$ is the total number of particles of the ith or kth phase taken into account; N is the total number of particles in the aggregate.

It is shown how one can determine a numerical scheme equivalent to this symmetrical matrix by counting in sections only. The different numbers of this matrix become equal when the arrangement of the grains in the aggregate is random.

These geometric functionals of rocks and ores promise to enable the petrologist to approach problems of phase relations and genesis by quantitative studies of intergrowth. So far the methods described were tested on granites, dolerites, charnockites, and chromite ores.

After the first investigations based on direct counting and measuring "by hand", semi- and full-scale automatic methods were designed and in part tried out. Complete automation promises to secure the above metrical parameters of rocks and ores within a few minutes after sectioning of a rock. Various measurements of classical petrofabric analysis result as a by-product of this automation; for example measurements of anisotropy, i.e., elongations of certain grains in certain directions.

SYN-OROGENIC NEPHELINE ROCKS IN EASTERN ONTARIO AND NORTHERN NORWAY

E. C. Appleyard

Department of Earth Sciences, University of Waterloo, Waterloo, Ontario

Syn-orogenic nepheline-bearing and related alkaline rocks occur in fold belts of various ages around the world. Most of these rocks are gneissic; some have the structure of intrusive plutons while others occur as migmatite-like or banded gneiss complexes. Examples of rocks of this origin are described from eastern Ontario and the island of Söröy, northern Norway. The identification of such occurrences as syn-orogenic rather than pre-orogenic depends on structural and textural criteria.

The Söröy alkaline rocks were emplaced into a complex of metasedimentary and metamorphosed igneous rocks during the course of the Caledonian orogeny. Structural analysis indicates that they formed concurrently with the second major phase of deformation but were strongly folded and sheared during late expressions of this movement phase. A great variety of alkaline gneisses, many of which are nepheline-bearing, resulted from the introduction of a highly fluid nepheline-pegmatite magma which injected or permeated into the host rocks according to the physical condition of the latter. Rocks of carbonatitic affinities with allied fenites are also present.

In eastern Ontario both igneous and metasomatic varieties of alkaline rocks are present and were emplaced during the Grenville orogeny. Detailed work on the Wolfe Belt of Lyndoch township, one of the metasomatic occurrences, suggests that these gneisses acquired their alkaline characteristics during the lull between the first and second major phases of deformation. The igneous varieties are probably coeval with the metasomatic and are attributed to be the source of the nephelinizing fluids throughout the eastern Ontario alkaline district. However, in many cases, including that of the Wolfe Belt, a direct relationship between igneous and metasomatic rocks cannot be demonstrated.

GEOCHEMISTRY OF NORANDA, QUEBEC, VOLCANIC ROCKS

W. R. A. Baragar

Geological Survey of Canada, Ottawa, Ontario

Volcanic rocks revealed in a cross-section of part of the Noranda volcanic belt, 10 to 15 miles west and southwest of Lac Duparquet, Quebec, form the north limb of a regional synclinorium. Dips are generally southward but the continuity of the stratigraphic succession is broken by a small double fold within the cross-section. North of this fold a steeply-dipping part of the assemblage is about 40,000 feet thick whereas south of it a shallow- to flat-dipping part is about 5,000 feet thick. The latter lies at the centre of the synclinorium and must be at least partly younger than the thick sequence north of the fold but their full stratigraphic relationships are uncertain.

The section was mapped in detail and sampled at stratigraphic intervals of about 400 feet. Each sample was analyzed for major elements by x-ray fluorescence and rapid chemical methods and composite samples were checked by classical chemical analyses.

The assemblage is composed essentially of basalt and andesite mostly of submarine deposition. Acid volcanic rocks, prevalent in assemblages a few miles eastward, are represented by minor fragmental rocks of mixed acid-basic composition in the upper part of the section.